IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION OF:	)	POSITIVE PHOTORESIST
Masaki KURIHARA	)	COMPOSITION
Takako SUZUKI	)	
Kenji MARUYAMA	)	
Satoshi NIIKURA	)	
Kousuke DOI	)	
SERIAL No. 10/035,137	)	GROUP ART UNIT: 1752
FILED: Jan. 4, 2002	)	EXAMINER: CHU,JOHN S Y

HONORABLE COMMISSIONER OF
PATENTS AND TRADEMARKS
WASHINGTON, D.C. 20231

SIR:

DECLARATION UNDER RULE 132

TAKAKO SUZUKI, being one of the inventors of the above identified application and a citizen of Japan residing at 150, Nakamaruko, Nakahara-ku, Kawasaki-shi, Kanagawa,211-0012, Japan, does hereby declare the following facts pertinent to the application namely, that:

1. She graduated from Gakushuin University, Faculty of Science, the Department of Chemistry.

2. Since 1995 she has worked for Tokyo Ohka Kogyo Co.,LTD. belonging to the Material Research & Development Division Semiconductor Materials Section 1.

3. She is familiar with the related arts of positive photoresist compositions and the references cited by the Examiner in connection with the captioned application.

4. Experiments were conducted under her supervision in order to provide comparative data regarding the effects of sensitivity, definition and shrink evaluation when the sensitizer described in the Claims was replaced with other than ingredient (C).

5.1 Purport of the experiments

By confirming the effect of causing less shrink exhibited by the composition replaced c1 composing Example 2 described in the specification with c5, c6 and c7 composing Comparative Examples 1, 2 and 3, the composition composed of ingredient (B) described in the Claims and ingredient (C) described in the Claims exhibit the remarkable effect of causing less shrink.

5.2 Materials used in the experiments:

A series of photoresist compositions was prepared in the same manner as in Example 1 of this application, except that the ingredients (B) and (C) used in Example 1 were changed to those indicated in Table 1. The ingredients (A), (b2), (c5), (c6) and (c7) were used in the Examples described in the specification, and were explained in detail.

Table 1

	Ingredient (B) (compositional ratio (wt.%))	Ingredient (C) (compositional ratio (wt.%))
1	b2(100)	c5(100)
2	b2(100)	c6(100)
3	b2(100)	c7(100)

In 510 parts by weight of solvent mixture[ethyl lactate/butyl acetate = 9/1(by weight)], 100 parts by weight of the ingredient (A), 50 parts by weight of the ingredient

(B) and 30 parts by weight of ingredient (C) were dissolved, the resulting solution was filtrated through a 0.2-μm membrane filter and thereby yielded a positive photoresist composition.

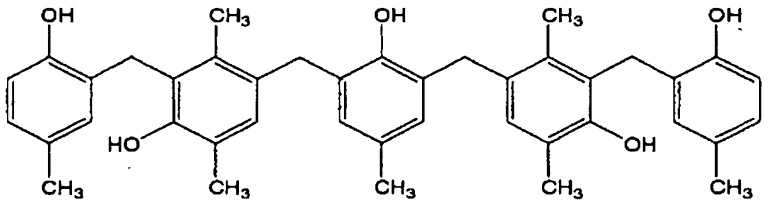
Each ingredient is explained in detail below.

(1) Ingredient (A):

An alkali-soluble resin comprising 50 parts by weight of novolak resin (a1) and 50 parts by weight of novolak resin(a2). The novolak resin (a1) had a weight average molecular weight (Mw) in terms of polystyrene of 5000 and a molecular weight distribution (Mw/Mn) of 3.0 and was prepared from m-cresol/p-cresol/2,3,5-trimethylphenol=35/40/25(by mole of charged material) using formaldehyde as a condensing agent. The novolak resin (a2) had a weight average molecular weight (Mw) in terms of polystyrene of 5000 and a molecular weight distribution (Mw/Mn) of 3.0 and was prepared from m-cresol/p-cresol=42.5/57.5 (by mole of charged material) using formaldehyde as a condensing agent.

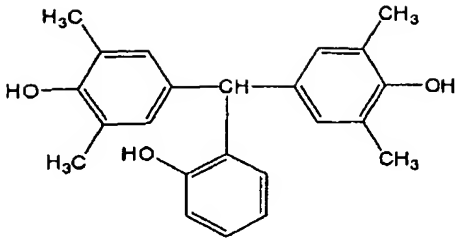
(2) Ingredient (B):

(b2) A reaction product (esterification rate : 40%) between 1 mole of the following phenol compound and 2 moles of 5-NQD:

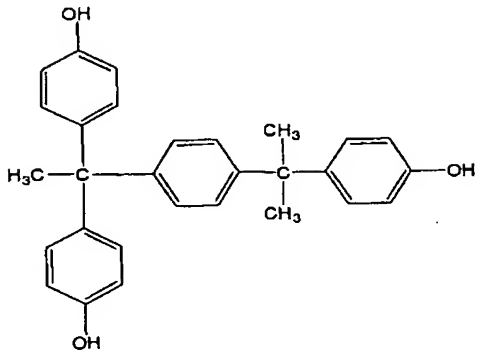


(3) Ingredient (C):

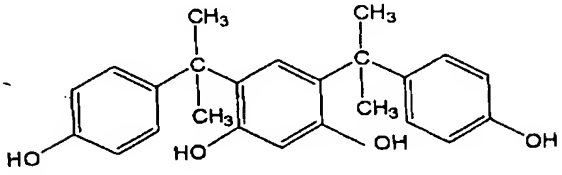
c5 : The following compound



c6 : The following compound



c7: The following compound



5.3 Method for testing:

By the same manner as in Example 1, the sensitivity, definition and shrink were evaluated regarding the above described compositions. The methods for each evaluation are explained below.

(1) Sensitivity

A sample was applied onto a silicon wafer using a

spinner, and was dried on a hot plate at 90℃ for 90 sec. to form a resist film 1.0 μm thick. The resist film was then irradiated with light through a mask (reticle) corresponding to a 0.35-μm resist pattern with a line-and-space (L&S) width of 1:1 for an increasing period from 0.1 sec. at intervals of 0.01 sec. using a reducing-type projection alinger NSR-2005i10D (available from Nikon Corporation, Japan; NA = 0.57). The film was then post-exposure baked (PEB) at 110℃ for 90 sec.; was subject to developing in a 2.38% by weight tetramethylammonium hydroxide aqueous solution at 23℃ for 60 sec., was rinsed with water for 30 sec., and was dried. In this procedure, the sensitivity was defined as the exposure time period(Eop) in milliseconds (ms) to exactly reproduce a 0.35-μm mask pattern with a line-and-space (L&S) width of 1:1.

(2)Definition

The definition was defined as the critical definition at an exposure to reproduce a 0.35-μm mask pattern.

(3) Shrink Evaluation

A sample was applied onto a silicon wafer using a spinner and was dried on a hot plate at 90℃ for 90 sec. to form a resist film 1.0-μm thick. The resist film was then irradiated with light through a mask (reticle) corresponding to five parallel resist trace 0.35-μm wide and 1.0-μm long with a line-and-space (L&S) width of 1:1 for an increasing period from 0.1 sec. at intervals of 0.01 sec. using a reducing type projection alinger NSR-2005i10D (available from Nikon Corporation, Japan; NA = 0.57).

In this procedure, the resist film was irradiated at the optimum exposure time period (Eop) under the condition that the focus was shifted 1.0μm from the optimum position of the focus toward the minus side (the upper side of the substrate).

The film was then post-exposure baked (PEB) at 110℃ for 90 sec.; was subject to developing in a 2.38% by weight

tetramethylammonium hydroxide aqueous solution at 23℃ for 60 sec., was rinsed with water for 30 sec., and was dried. In this procedure, the shrink was evaluated in accordance with the following criteria by taking the lengths in a longitudinal direction of the two resist traces at both ends of the five parallel resist traces as an index.

(4) Criteria on Shrink Evaluation

Excellent: The lengths of the resulting traces of were equal to or more than 0.9μm and less than or equal to 1.0μm, indicating that almost no shrink occurred.

Good: The lengths of the resulting traces were equal to or more than 0.8μm and less than 0.9 μm, indicating that some shrink occurred.

Fair: The lengths of the resulting traces were equal to or more than 0.7μm and less than 0.8μm.

Failure: The lengths of the resulting trace were trace less than 0.7μm.

5.4 Evaluation and Considerations:

The results are shown in Table 2 below, and results of Ex.2 were added to Table 2.

Table 2.

	Sensitivity (ms)	Definition (μm)	Shrink Evaluation
1	460	0.32	Fair
2	430	0.32	Fair
3	460	0.32	Fair
Ex.2	430	0.30	Excellent

As shown in Table 2, the results of all samples were 'Fair', with respect to Shrink Evaluation. The compositions containing b2 as ingredient (B) and the sensitizer other than ingredient (C) (c5, c6 and c7 as described above)

exhibit shrink. Thus, it is evident that it is necessary to mix ingredient b2 with ingredient c1 in order to cause less shrink.

On the other hand, as described in the specification of this application, Comp.Ex.4 and Comp.Ex.5 both exhibit shrink.

Thus, in order to cause less shrink, it is evident that it is necessary to mix ingredient (B) described in the Claims with ingredient (C) described in the Claims

She hereby declares that all statements made herein of her own knowledge are true and that all statements made on information and belief are believed to be true; and further she is hereby warned that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of title 18 of the United States Code and that such willful, false statements may jeopardize the validity of the application or any registration resulting therefrom.

Takako Suzuki

TAKAKO SUZUKI

Date: April 6 , 2004.